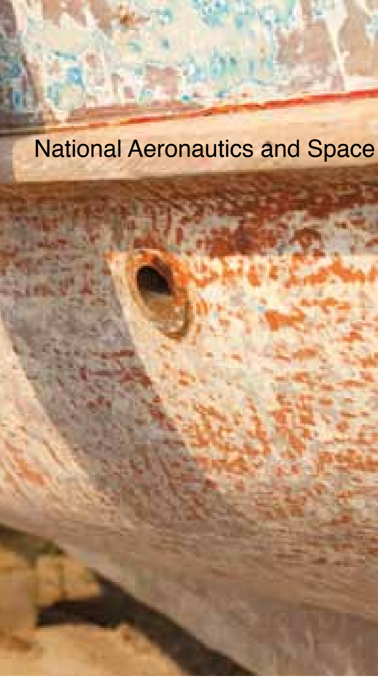

National Aeronautics and Space Administration

# NASA Langley's

## Particle Contamination Mitigation Methods

Unique surface properties such as increased hydrophobicity and self-cleaning

NASA's Langley researchers offer you methods for particle contamination mitigation. The methods were developed for exploration of surfaces such as Moon, Mars, and asteroids. During past missions, lunar dust caused an array of issues including compromised seals, clogged filters, abraded visors and space suit surfaces, and was a significant health concern. NASA's novel methods for particle contamination mitigation include both controlled chemical and topographical modifications. These methods offer a wealth of applications and commercial opportunities. The benefits include films, coatings, and surface treatments with antifouling, dust resistance, hydrophobic to superhydrophic, low adhesion/friction, and self-cleaning characteristics. NASA is seeking development partners.

### Benefits

- Antifouling
- Dust resistant
- Hydrophobic to superhydrophobic
- Low adhesion/friction
- Self-cleaning

partnership opportunity

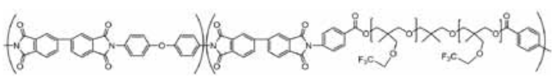

Figure 1. Chemical structure of copolyimide oxetane

## The Technology

NASA's novel methods include both controlled chemical and topographical modifications. The methods available for further development are novel copolyimide oxetanes and modified surface energy via laser ablative surface patterning. The following methods can be used individually or in combination to generate superhydrophobic surfaces:

Synthesis of novel copolyimide oxetanes with unique surface properties

The technology is the synthesis of a polyimide coating or film with a modified surface chemistry shown in Figure 1. A minor amount of an oxetane reactant containing fluorine is added to the polyimide, and the oxetane preferentially migrates to the surface, enabling relatively high concentrations of fluorine at the surface, without compromising the functional performance of the bulk of the polymide coating/film.

The copolymers exhibit mitigation of particle adhesion and fouling from exposure to various particulate and biological contaminants and exhibit reduced surface energy and increased surface fluorine content at extremely low oxetane loadings relative to the imide matrix (see Figure 2). Additionally, the short fluorinated carbon chains do not bioaccumulate, reducing the environmental impact of these materials.

Modifying surface energy via laser ablative surface patterning

This method uses a laser to create nanoscale patterns in the surface of a material to increase the hydrophobicity of the surface (see Figure 2). The benefits of hydrophobic surfaces include decreases in friction and increases in self-cleaning properties.

This is an advantageous method of surface modification because it is fast and single-step, promises to be scalable, requires no chemicals, could be applied to a variety of materials, and does not require a planar surface for patterning.

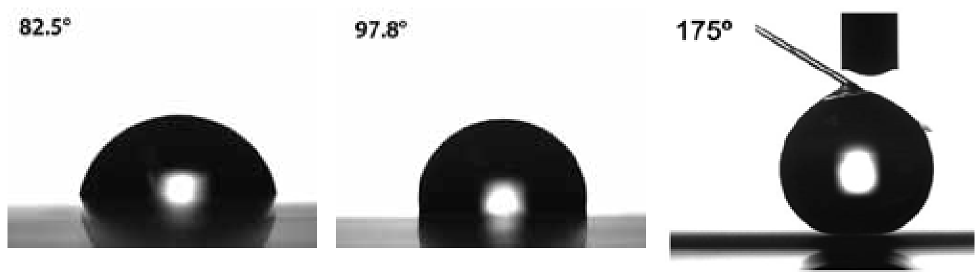


Figure 2. Water droplet with varying surface modifications

## Applications

- Biological templating
- Biomedical devices
- Corrosion and stain resistance
- Drag reduction
- Reduced ice and water adhesion
- Reduced insect adhesion on aircraft/automobiles
- Marine antifouling coatings
- Microfluidics
- Particle and biological contaminant mitigation
- Self-cleaning of many kinds of surfaces
- Sensors
- Surface-specific chemical sensing

## For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

The Technology Gateway

National Aeronautics and Space Administration

**Langley Research Center**
Mail Stop 218
Hampton, VA 23681
757.864.1178
LARC-DL-technologygateway@mail.nasa.gov
technologygateway.nasa.gov

**www.nasa.gov**

TOA 111
NP-2011-09-424-LaRC

LAR 18026-1, LAR 17769-1